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The Effects of Personality and Risk Preferences on Effort-Based Behavior: A Game Theoretic Approach

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The Effects of Personality and Risk Preferences on Effort-Based Behavior: A Game Theoretic Approach

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Abstract

Our personality and preferences play a major role in the decisions we make in our everyday lives. Drawing from literature exploring how people innovate under different scenarios (Dubina, 2013), the present study expanded this topic to include any scenario where there is incentive to free-ride off of another's effort. I designed a study in which participants (*N*=73) were asked to complete the Big 5 personality questionnaire, a cognitive reflection task, an altruism elicitation task, and a risk elicitation task, then were randomly paired with another participant to complete four different rounds of a public goods game. Each round of the game involved a unique incentive structure, in which participants could choose to be generous or to free-ride off of their partner's contributions. Participants were more likely to act generously in a cooperative environment than a control environment, and were even more likely to act generously under a competitive environment. Additionally, altruistic participants were more likely to act generously across all rounds. However, personality traits and risk preferences did not play a major role in participants' behavior in the public goods game. These findings provide some insights into which factors drive human behavior and decision making when there is incentive to free-ride, and specifically show that economic incentives are the strongest driving force in these scenarios.

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I. Introduction

Many situations we find ourselves facing in our daily lives involve public goods, which are defined as non-excludable items which multiple parties can consume (Cowen, 1985). However, we often do not recognize the nature of these items until they need to be maintained or replaced. For instance, the roads we drive, walk, bike, and jog on every day are an example of a public good, as they are used by many people, and one person's use of the road does not exclude other people from using the road. However, when the road falls into disrepair, such as developing pot holes, cracks, or bumps, the people who use the roads on a daily basis are not the ones who fix the roads, as they are not directly responsible for the maintenance of the roads. Due to this, it can take the local government a good amount of time to fix the roads, as they need to budget taxpayers' money for many projects around the area. Having many people use the public good without a specific party in charge of maintaining and replacing it can lead to the rapid depletion of the good, as people continue to consume it while hoping someone else takes responsibility to maintain it. This incentive to free-ride on other people's behaviors can be extended to nearly every scenario involving a public good, which includes infrastructure maintenance, funding a new building, and exerting effort in group settings. This can extend to any type of group project, where group members are incentivized to contribute as little as possible in the hopes that one person will step up and contribute a high amount of effort so that the project can be completed.

Working in different environments is a crucial skill that helps carry us through many stages of our life, from high school to practically any career path. However, certain factors may play a role in determining which of these environments individuals best work under. Individual differences, such as personality traits, risk preferences, and demographic information may be a

major factor in how people behave and interact with each other, especially when they are required to exert effort to achieve a goal. To this end, this paper analyzes data obtained from a study conducted at Colby College which explored the intersection of personality traits, risk preferences, demographic information, and economic incentives to investigate how people behave in different environments. Specifically, I developed an experiment to test if Game Theory can be used to analyze how generous people of different personality types, risk attitudes, and demographics will behave under environments with varying incentives. I hypothesized that people with different personalities, risk preferences, and demographics will behave differently under different incentive structures, as these factors play a role in conditions under which people are best able to perform. For instance, risk-averse people may perform better under an incentive structure in which their payoff is a percentage of the effort they put in, as they are guaranteed some positive payoff, while risk-loving people may perform better under the lump-sum incentive structure, in which they would receive a fixed payoff if they reach a specified effort level, and nothing if they do not reach this goal.

II. Literature Review

Although some solutions have been presented to solve the issue created by the nature of public goods, they do not offer a perfect resolution for every public goods scenario. For instance, the Coase Theorem suggests assigning property rights to the public good as a solution, forcing one party to take responsibility for maintaining and replacing the good (Coase, 1960). However, in scenarios such as group work, this solution would mean assigning different parts of the project to different people, thus reducing the collaborative environment that is often the goal of group work. Additionally, different people may react differently to these possible solutions. Risk preferences may play a role in group scenarios, as people who are more risk-averse may be more

inclined to exert higher effort levels, as they do not want to risk the project not getting completed. Additionally, personality traits may come into play, as these may drive how comfortable someone is with sharing ideas, challenging others' opinions, and working with other people. These possible factors, as well as why the Coase Theorem may not be the perfect solution to the public goods issue, are described in further detail below.

Public Goods

There are two main definitions under which public goods can fall under: joint and non-rivalrous consumption, and non-excludability (Cowen, 1985). Joint and non-rivalrous consumption is defined by the fact that one individual's consumption of the good does not prevent another individual from consuming the good, while non-excludability is defined as a good that, if one person consumes it, it cannot be withheld from all others in the group (Cowen, 1985). However, by nature of this joint, non-excludable consumption, a public good sets up the issue of everyone wanting to consume it, but nobody replacing or maintaining it.

Public goods often incentivize people to free-ride by consuming the good while not contributing time, money, or effort into replacing or maintaining the good, in the hopes that other people will take responsibility (Kindleberger, 1981). However, if everyone is incentivized to free ride, there is a heightened chance that everyone will choose to exploit the public good, depleting the resource completely. In order to prevent this, different incentive structures must be put in place to prevent free-riding and encourage taking responsibility for the public good.

Coase Theorem

The Coase Theorem suggests that a possible solution to the public goods issue is to assign property rights, thus eliminating the problem in which neither party is willing to exert effort to maintain the public good (Coase, 1960). However, the Coase Theorem relies heavily on

several assumptions, including that there must only be two parties to an externality, no transaction costs, perfect information, and competitive markets (Barzel & Kochin, 1992). Although assigning property rights turns the public good externality into a private good, and therefore, one party is responsible for exerting effort towards maintaining it, the Coase Theorem's suggested solution falls short on certain types of public goods. For any type of public good in which effort-based risk taking is involved, such as innovation and group projects, assigning property rights (i.e. assigning one person to do a certain part of a group project) would not necessarily be the best solution. By assigning property rights in these scenarios, important synergies between people and their ideas would be lost, and there is a higher chance of experiencing confirmation bias, as no one would be challenging the other person's ideas. Since confirmation bias occurs when an individual seeks or interprets ideas in ways that align with their own beliefs, having no one around to challenge or question a person's ideas and suggestions increases the risk for confirmation bias (Nickerson, 1998). This can be dangerous when generating ideas, as overlooking or ignoring information that does not support the ideal end result of the project could increase the risk of the project failing. Therefore, although the Coase Theorem suggests one solution for the public goods issue, it is not the best solution for all scenarios and types of public goods.

Rather than assigning property rights, another solution could be to have the two parties work together to solve the public goods issue. As seen in many work environments, this can be developed under different circumstances. One way this can be set up is by creating a competitive environment, where the two parties compete with each other to develop the best idea or solution to the problem, and the party with the best idea receives a reward in the form of full credit for the idea. Another option is to create a cooperative environment, where both parties collaborate to

create a solution, and then both reap the rewards of the idea. With this option especially, there is room for sharing and building different ideas, looking at the problem through different viewpoints, and double checking that there is no important information the parties are missing that could interfere with their solution.

Risk Preferences

Risk preferences can be determined based on a person's choice between two options. A choice is risk-averse if a certain outcome is preferred to a gamble of equal or greater expected monetary payoff, and a choice is risk-loving if a certain outcome is rejected in favor of a gamble with equal or lower expected monetary payoff (Kahenman & Tversky, 1982). A choice is risk-neutral if the person is indifferent between a gamble or a certain outcome. Kahenman & Tversky (1982) also describe the reflection effect, where they observed that people tend to be risk-averse in the gain domain and risk-loving in the loss domain. This suggests that people are more willing to take risks if they have already incurred a loss, as they are willing to gamble more to get back to a positive payoff. Holt & Laury (2014) found that women tend to be more risk-averse than men are, especially when making investment decisions. Additionally, Li & Liu (2008) found that although personality traits may play a role in risk preferences, examining personality alone does not provide sufficient information to logically and accurately predict risk preferences. This suggests that there may be many factors that contribute to risk preferences, but only examining one factor may not be sufficient to predict risk preferences.

Cognitive Reflection

Cognitive reflection tests provide a question with an intuitive incorrect answer that is meant to impulsively come to mind, but with some reflection, the correct answer should be clear (Frederick, 2005). Cognitive reflection has been found to be a strong indicator of

decision-making and risk preferences, as people who perform well on cognitive reflection tasks are more likely to spend more time reflecting on all of the options to make the best informed decision (Frederick, 2005). Compared to other measures of cognitive ability, such as the SAT or the ACT, the cognitive reflection test has an equal to or exceeding predictive validity in regards to decision making, making it an attractive quick measure of participants' cognitive reflection.

Effort-Based Risk Taking and the Role of Personality

Many different scenarios require us to exert effort to solve a problem, with the risk being a major loss of time and energy if the solution fails. One example of this type of scenario is when people are asked to come up with an innovative product or idea. In an economy where new ideas often give a firm an advantage in the market, companies are increasingly looking to hire innovators, or people who are able to introduce and apply new and improved ways of doing things (West & Farr, 1989). However, many companies may not be providing the correct environment to have certain people flourish as innovators, as different people may work best under different incentive structures.

Although there is plenty of literature analyzing how competition across firms drives innovation, there has been little research on how individuals within a firm innovate (Dubina, 2013). Dubina (2010) examines how different incentive structures affect innovation by running a series of computer simulations and determining whether or not an individual would put in effort to innovate based on these incentive structures. Other previous research has found that low-dogmatic people are more likely to innovate than high-dogmatic people, implying that risk preferences play a role in innovation, as perceived risk can induce anxiety, which high-dogmatics protect themselves against. (Jacoby, 1971). Additionally, another study found that out of the Big Five personality traits (conscientiousness, openness to experience, extraversion, agreeableness,

neuroticism), openness to experience had a significant positive impact on innovative behavior (Yesil & Sozbilir, 2012). Since openness to experience is also associated with active imagination, aesthetic sensitivity, attentiveness to inner feelings, and a preference for variety (Rothmann & Coetzer, 2003), it makes sense that people high in this personality trait would be more innovative. However, despite all these factors being shown to have an impact on innovative performance, there has not yet been a study examining the link between incentive structure, personality, risk attitudes, and demographics, which is what this project aims to do.

III. Method

Since we encounter many different types of public goods in our daily lives, it is interesting to imagine how different character traits could play a role in how people behave in these situations. In order to explore how different people behave in different public goods environments, I designed and conducted an experiment using participants from Colby College. Although previous research has focused on how people behave in a traditional public goods environment, there has been little previous focus on how individual character traits may play a role in how people make decisions. Additionally, there has been little previous research on how different economic incentives may affect how people make decisions in a public goods environment. With this in mind, I created my own experiment to highlight and fill these gaps in the literature. Designing my own experiment allowed me to observe the behavior of people around me, while also allowing me to target the specific individual traits I was interested in. Combining previous literature that explains the possible shortcomings of assigning property rights to a public good with research that highlights the role of risk preferences, cognitive reflection, and the Big 5 personality traits on people's behavior and decision making, I centered my experiment around these topics.

In order to conduct the experiment, I used the online platform Lioness, which allowed me to randomly pair participants to play multiple treatments of the public goods game against each other. I coded the experiment using JavaScript, according to the Lioness Reference Manual (Lioness, 2018). Participants were recruited from Colby College by reaching out to club mailing lists, class lists, and professors in the Economics Department to promote my study. In order to coordinate random pairings, participants signed up for sessions when the experiment would be active, then joined at their designated times. Two sessions were run in early March, and four sessions were run in early April, for a total of six sessions. During each session, participants completed the personality measure, cognitive reflection task, risk elicitation task, and altruism elicitation task individually, then were randomly paired with another participant to complete the four treatments of the public goods game. Finally, participants completed a demographics survey and were directed to a separate sheet where they submitted their name and Colby ID number so they could receive their earnings. The sheet with the data from the experiment was kept completely separate from the sheet with participants' personal information in order to maintain anonymity as stated in my IRB proposal.

Participants

Undergraduate students at Colby College participated in this study and were compensated monetarily. Participants were guaranteed at least $5 for participating, and could earn up to $10 based on their decisions, the decisions of their opponent, and lottery outcomes throughout the experiment. Table 1 below shows the summary statistics for participants:

Table 1: Participant Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
playerNr	73	8.945205	6.274128	1	26

age	50	21.22	1.085121	18	23
gender	49	1.55102	.6097069	1	3

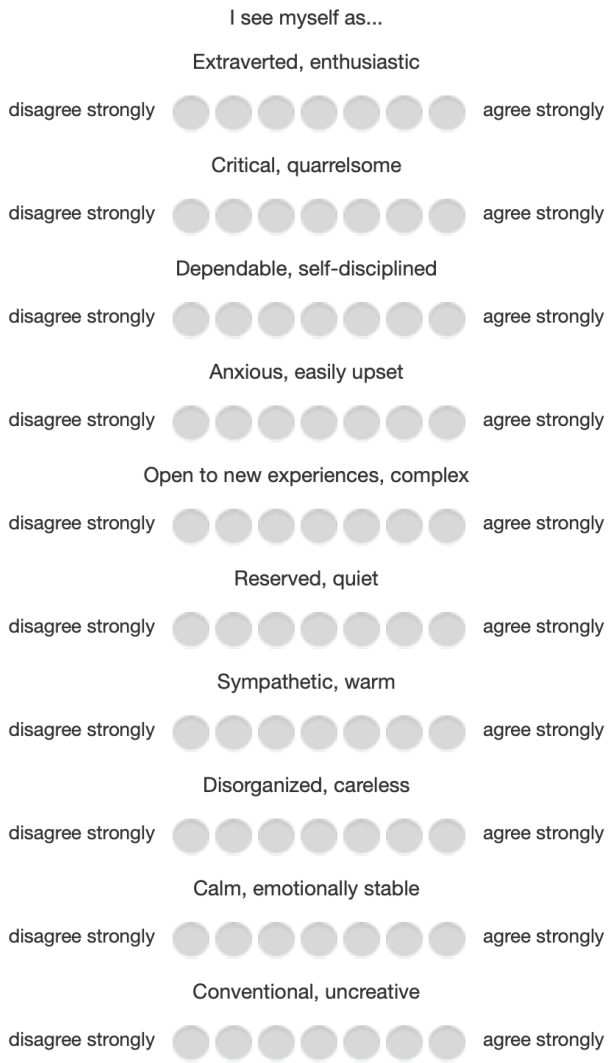
The table above shows that 73 people participated in my study, with an average age of 21.22. Gender was dummy-coded such that 1=male, 2=female, and 3=non-binary. The average for gender shows that most participants identified as male or female, but some participants did identify as non-binary. Specifically, there were 21 participants who identified as female. The change in observation numbers between the three variables indicate that not everyone completed the demographics survey at the end of the experiment. This could be due to participants accidentally leaving the experiment too quickly, or other technical issues.

Procedure and Materials

Participants completed an online survey to examine their behavior under different environments. After providing informed consent, all participants began the study by completing the Big Five Inventory (Gosling et al., 2003). All participants then completed a creative thinking puzzle task before being presented with a risk elicitation task (Holt & Laury, 2002). Participants then completed the dictator game as an altruism elicitation task. Participants were then presented with the instructions for the Public Goods game, and had to correctly answer four control questions to ensure they understood the incentives of the game before continuing. Participants were then paired up to complete four treatments of the Public Goods game, with varying incentive structures in each treatment. The participants then completed a demographics survey, and, upon completion, were debriefed by a written document at the end of the study. I expand on each of these measures below.

Big Five Personality Inventory. Participants answered 10 questions in accordance with the questionnaire created by Gosling et al. (2003) to determine how they scored in terms of

extraversion, agreeableness, conscientiousness, openness to experience, and emotional stability. Participants were asked to rank how much they agreed with the statement provided on a scale of 1-7. The statements participants ranked are shown below:



Cognitive Reflection Task. After completing the Big Five index, participants completed a cognitive reflection task, where they were presented with a logic puzzle. The puzzle asked "A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?" This task served as a cognitive measure to examine how this level of reflection might impact participants' decisions later in the experiment. Since performance on cognitive reflection

tasks has been found to relate to better informed decision making, participants who perform better on this cognitive reflection task may better understand the instructions and incentives of the next stages of the experiment.

Risk Elicitation Task. Participants were presented with nine multiple choice questions, each with two options, in accordance with the measure created by Holt and Laury (2002). Each question presented a safe option, such as "1/10 chance of receiving $2 and 9/10 chance of receiving $1.60," and a risky option, such as "1/10 chance of receiving $3.85 and 9/10 chance of receiving $0.10." The probability of receiving the higher payoff ($2 or $3.85) increased by 1/10 with each question, and the probability of receiving the lower payoff ($1.60 or $0.10) decreased by the same amount with each question. The table of options the participants were presented with is shown below:

Option A: 1/10 of $2, 9/10 of $1.60	Option B: 1/10 of $3.85, 9/10 of $0.10
Option A: 2/10 of $2, 8/10 of $1.60	Option B: 2/10 of $3.85, 8/10 of $0.10
Option A: 3/10 of $2, 7/10 of $1.60	Option B: 3/10 of $3.85, 7/10 of $0.10
Option A: 4/10 of $2, 6/10 of $1.60	Option B: 4/10 of $3.85, 6/10 of $0.10
Option A: 5/10 of $2, 5/10 of $1.60	Option B: 5/10 of $3.85, 5/10 of $0.10
Option A: 6/10 of $2, 4/10 of $1.60	Option B: 6/10 of $3.85, 4/10 of $0.10
Option A: 7/10 of $2, 3/10 of $1.60	Option B: 7/10 of $3.85, 3/10 of $0.10
Option A: 8/10 of $2, 2/10 of $1.60	Option B: 8/10 of $3.85, 2/10 of $0.10
Option A: 9/10 of $2, 1/10 of $1.60	Option B: 9/10 of $3.85, 1/10 of $0.10

Option A is considered the safe option, as the difference between the high and low payoffs is only $0.40, while Option B is considered the risky option, as the difference between the high and low payoffs is $3.75. In accordance with Holt & Laury (2002), risk loving people

would choose between 0 and 3 safe options before switching to the risky options, risk neutral people would choose 4 safe options, and risk averse people would choose between 5 and 9 safe options. The risk preferences of participants was measured by where their switching point from safe options to risky options occurred.

Altruism Elicitation Task. Participants played the Dictator Game in order to elicit altruistic attitudes. In this game, they were given 10 points, and had the option to give anywhere between 0-10 points to their opponent. Considering the incentives of this game are to keep all 10 points for yourself, giving more points to their opponent was considered more altruistic behavior, while giving fewer points to their opponent was considered less altruistic behavior.

Public Goods Games. Participants were randomly paired up to complete four treatments of a Public Goods game, with varying incentive structures in each treatment. In each treatment, participants were given 10 tokens, and could choose to put anywhere between 0-10 tokens into a communal pot. In the first treatment, the traditional Public Goods game was played, in which the communal pot was multiplied by 1.5, and the resulting total tokens were divided evenly between the two participants. In the second treatment, which I refer to as the cooperative environment, the pot was only multiplied by 1.5 if at least fifteen tokens were put in the pot between the participants. If the threshold of fifteen tokens was not reached, participants lost any tokens they originally invested. In the third treatment of the game, which I refer to as the competitive environment, the multiplied pot was distributed in proportion to the amount of tokens each participant originally put in. In the fourth treatment, which I refer to as the dynamic environment, one participant was randomly selected to determine an amount of tokens to put in the pot first, and the other player observed this and then decided how many tokens to put in the pot.

Demographic Items. Participants were asked to report their age, gender, race, native language, majors, and previous familiarity with the study itself.

V. Results

In order to be able to analyze participants' decisions across all four treatments of the game, the data was stacked such that a new variable, *overallcontr*, could be created. This variable represents the contribution across all four treatments of the public goods game. Due to this, the number of observations seen in Table 2 below is four times the 73 participants.

Table 2: Variable Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
extraversion	292	4.89726	1.709	1	8
agreeableness	292	5.143836	1.343124	3	8
conscientiousness	292	5.308219	1.444578	2	8
emotional stability	292	4.938356	1.624438	1	8
openness to experience	292	5.678082	1.143846	3.5	8
riskpref	292	2.986301	2.69143	0	9
crt	292	.5205479	.5004352	0	1
altruism	260	2.646154	2.742097	0	10
gender	196	1.55102	.6097069	1	3
overallcontr	292	4.671233	4.483049	0	10

As seen in the table above, participants generally scored high on all of the Big 5 Personality Traits, as "strongly agree" was represented by a 7 on the likert scale. A score of 8 indicates that the participant did not fill out the survey. Participants were also on average risk loving, with an average score of 2.99. This was surprising, as the general population tends to be

risk averse. Participants generally scored low on the altruism elicitation task, which aligns with the incentives of the Dictator Game. Finally, the average contribution across all four rounds was 4.67, with a range from 0 to 10 points. This implies that participants ranged from being very generous to not generous at all, but overall leaned on the less generous side. Taken together, these trends motivate the empirical model described below.

Multiple regression methods were used in this and subsequent analyses. Overall contribution across the four rounds was regressed on the different rounds, each of which had a unique incentive structure. Altruism, risk preferences, gender, and cognitive reflection were then added to the model, which is shown in the equation below:

$$Overall\ contribution_i = \beta_0 + \beta_1 roundgame_i + \beta_2 altruism_i + \beta_3 gender_i + \beta_4 riskpreference_i + \beta_5 crt_i + e_i$$

In this equation, *Overall contribution*$_i$ represents the total amount contributed across the four rounds. Across the four rounds, *roundgame* represents a dummy variable, which is equal to 1 if round = i and equal to 0 if round ≠ i. Here, four dummy variables were created, one for the first round (the omitted group), 2.roundgame for the second round, 3.roundgame for the third round, and 4.roundgame for the fourth round. *Altruism* represents the amount of points participants gave to their opponent in the Dictator Game, and *gender* is a dummy variable for the participant's gender, and this is equal to 1 if gender = i and 0 if gender ≠ i. This means that three dummy variables were created, one for male (which was the omitted group), 2.gender for female, and 3.gender for non-binary. *Riskpreference* represents the risk attitudes of the participant on a scale of 1-9, with 1 being "highly risk loving" and 9 being "stay in bed," or, extremely risk averse. *Crt* is a dummy variable for performance on the cognitive reflection task, and this is equal to 1 if the participant got the answer correct.

I hypothesized that personality traits, risk preferences, and demographics would play a role in how people made decisions about how much to contribute to the communal pot. Additionally, I hypothesized that the different types of treatments would have an effect on participants' decisions as well. The results are shown in the table below.

Table 3: The Effect of Economic Variables on Overall Contribution

	(1)	(2)	(3)	(4)	(5)
VARIABLES	overallcontribution	overallcontribution	overallcontribution	overallcontribution	overallcontribution
2.roundgame	1.178	1.277*	1.729**	1.729**	1.729**
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)
3.roundgame	2.548***	2.862***	3.875***	3.875***	3.875***
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)
4.roundgame	-0	-0	-0	-0	-0
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)
altruism		0.287***	0.289***	0.300***	0.302***
		(0.0967)	(0.107)	(0.108)	(0.108)
2.gender			-0.484	-0.554	-0.389
			(0.547)	(0.554)	(0.581)
3.gender			-0.651	-0.794	-0.583
			(1.143)	(1.155)	(1.177)
riskpref				0.0820	0.0772
				(0.0933)	(0.0934)
crt					0.513
					(0.549)
Constant	3.740***	3.363***	4.874***	4.606***	4.232***
	(0.513)	(0.588)	(0.598)	(0.671)	(0.782)
Observations	292	260	192	192	192

R-squared	0.055	0.101	0.202	0.206	0.209

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As seen in Table 3, only the round of the game and altruism are significant. The round of game results suggest that compared to the omitted group, round 1, in round 2 participants contributed 1.729 more points, in round 3 participants contributed 3.875 more points, and in round 4 participants contributed about the same as they did in the original round. These results can be explained by the incentives for round 2, which are structured such that if an individual decides to cooperate with their partner, they have to contribute at least 5 points in order to reach the threshold of 15, assuming their partner contributed 10. However, if the player decides not to cooperate, they are incentivized to contribute 0 points, or else they will lose points. Additionally, in round 3, participants are incentivized to contribute 10 points, as their payoff is proportional to what they put in, leading to a contribution of 10 maximizing their payoff. In round 4, the incentive structure does not change much from the first round, as participants are given an opportunity to witness what their rival decided before they make their contribution, without their payoff being affected by their decision more than it is in round 1.

Beyond the economic incentives, the significance of altruism across all rounds can be explained by the fact that altruistic people take the well-being of others into account when making decisions, and thus would be more likely to try to increase the overall payoff of the group by contributing more points. These results imply that altruism and economic incentives are the strongest driver behind how much participants decided to contribute. In order to explore the effect of other factors in more depth, I then investigated each round separately, focusing on the effect of altruism, gender, risk preferences, and cognitive reflection on the contribution for each round. The results are shown in Table 4 below.

Table 4: The Effect of Economic Variables on Contribution Across Rounds

	(1)	(2)	(3)	(4)
VARIABLES	contribution	contribution2	contribution3	contribution4
altruism	0.269	0.409*	0.0125	0.457*
	(0.252)	(0.220)	(0.124)	(0.258)
2.gender	0.859	-0.956	-0.595	-0.711
	(1.353)	(1.187)	(0.668)	(1.431)
3.gender	-0.0341	-1.646	0.272	-0.857
	(2.742)	(2.381)	(1.354)	(2.823)
riskpref	0.163	-0.0193	0.110	-0.0629
	(0.218)	(0.191)	(0.107)	(0.229)
crt	0.738	0.835	-0.399	0.779
	(1.279)	(1.141)	(0.631)	(1.339)
Constant	3.312**	6.270***	9.319***	4.432***
	(1.505)	(1.403)	(0.743)	(1.545)
Observations	48	47	48	47
R-squared	0.061	0.097	0.050	0.084

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4 shows that although altruism is still the only significant variable, it is only significant for round 2 and round 4. This implies that when the economic incentives are structured in a way in which one person's payoff is directly affected by the payoff of another person, more altruistic people will contribute more. For instance, in round 2, where the participants had to work together to reach 15 points at the risk of not reaching the threshold and losing any points they had contributed, more altruistic people would be more likely to cooperate and contribute higher amounts, as they want the group to succeed. However, in round 3, in which

participants' payoffs were only determined by the amount they contributed, altruism is no longer significant, as neither player in the pairing is affected by the other's decisions. Additionally, in round 4, in which one player went first, and the other player observed this contribution before making their own decision, more altruistic people would also be more likely to contribute higher amounts in order to help out the other player in their group. To explore this further, I then analyzed the actions of player "B," to examine how they reacted to player "A" putting an additional point in the pot to start. The results are shown in Table 4b below.

Table 4b: Analysis of Dynamic Game

	(1)	(2)	(3)	(4)	(5)
VARIABLES	contribution	contribution2	contribution3	contribution4	contribution4B
altruism	0.269	0.409*	0.0125	0.457*	0.0450
	(0.252)	(0.220)	(0.124)	(0.258)	(0.298)
2.gender	0.859	-0.956	-0.595	-0.711	0.485
	(1.353)	(1.187)	(0.668)	(1.431)	(1.994)
3.gender	-0.0341	-1.646	0.272	-0.857	3.850
	(2.742)	(2.381)	(1.354)	(2.823)	(3.405)
riskpref	0.163	-0.0193	0.110	-0.0629	-0.298
	(0.218)	(0.191)	(0.107)	(0.229)	(0.348)
crt	0.738	0.835	-0.399	0.779	1.721
	(1.279)	(1.141)	(0.631)	(1.339)	(1.917)
rivalcontr					0.937***
					(0.250)
Constant	3.312**	6.270***	9.319***	4.432***	-1.636
	(1.505)	(1.403)	(0.743)	(1.545)	(3.063)
Observations	48	47	48	47	22
R-squared	0.061	0.097	0.050	0.084	0.547

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4b shows that for every additional point player A contributed at the start, player B contributed 0.937 more points, which is almost an exactly proportional increase in player B's behavior in response to player A's behavior. This implies that player B most likely uses a "tit-for-tat" strategy when making decisions, where they decide to reciprocate if player A is generous, but not put in as much if player A is not.

Although economic and demographic variables do not seem to play a major role in participants' contribution amounts, there may be other factors at play. To investigate this, overall contribution across rounds was regressed on the Big 5 personality traits. This is represented in the equation below:

$$Overall\ contribution_i = \beta_0 + \beta_1 roundgame + \beta_2 extraversion_i + \beta_3 greeableness_i + \beta_4 conscientiousness_i + \beta_5 emotionalstability_i + \beta_6 opennesstoexperience + e_i$$

In this equation, *overall contribution* and *roundgame* are the same as in the first equation. *Extraversion*, *agreeableness*, *conscientiousness*, *emotionalstability*, and *opennesstoexperience* represent the Big 5 factors of the same name, all ranging on a scale of 1-7. The results are shown in the table below.

Table 5: The Effect of Personality on Overall Contribution

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	overallcontr	overallcontr	overallcontr	overallcontr	overallcontr	overallcontr	overallcontr
2.roundgame	1.178	1.178*	1.178*	1.178*	1.178*	1.178*	1.178*
	(0.725)	(0.699)	(0.692)	(0.686)	(0.665)	(0.653)	(0.654)
3.roundgame	2.548***	2.548***	2.548***	2.548***	2.548***	2.548***	2.548***

	(0.725)	(0.699)	(0.692)	(0.686)	(0.665)	(0.653)	(0.654)
4.roundgame	-0	-0	-0	-0	-0	-0	-0
	(0.725)	(0.699)	(0.692)	(0.686)	(0.665)	(0.653)	(0.654)
extraversion		-0.696***				-0.148	-0.149
		(0.145)				(0.159)	(0.159)
agreeableness			-0.985***			-0.340	-0.355
			(0.182)			(0.207)	(0.228)
conscientiousness				-0.992***		-0.413**	-0.413**
				(0.168)		(0.194)	(0.195)
emotionalstability					-1.076***	-0.721***	-0.730***
					(0.145)	(0.176)	(0.187)
opennesstoexperience							0.0403
							(0.263)
Constant	3.740***	7.147***	8.807***	9.006***	9.051***	11.97***	11.86***
	(0.513)	(0.864)	(1.059)	(1.016)	(0.857)	(1.149)	(1.346)
Observations	292	292	292	292	292	292	292
R-squared	0.055	0.125	0.142	0.157	0.207	0.245	0.245

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5 shows that the economic incentives are still the main driver of contribution amount, but the personality traits of conscientiousness and emotional stability may also be playing a role. The negative coefficient on emotional stability can be explained by the fact that people who are more neurotic or anxious (i.e. less emotionally stable) may be more concerned about what their opponent thinks of them, and therefore may be more likely to contribute more. The negative coefficient on conscientiousness can be explained by the fact that conscientious people can be inflexible perfectionists, and this could translate to a desire to get the maximum payoff possible, which would come from undercutting their opponent. In order to further explore

how personality traits play a role in each round, I then examined each round separately, and the results are shown in Table 6 below.

Table 6: The Effects on Personality Across Rounds

	(1)	(2)	(3)	(4)
VARIABLES	contribution	contribution2	contribution3	contribution4
extraversion	0.386	0.152	0.0524	0.607
	(0.386)	(0.357)	(0.208)	(0.426)
agreeableness	-0.191	-0.557	0.0196	0.554
	(0.552)	(0.511)	(0.297)	(0.611)
conscientiousness	-1.003**	0.110	-0.368	0.0444
	(0.440)	(0.409)	(0.237)	(0.490)
emotionalstability	-0.567	-0.629	-0.118	-0.604
	(0.410)	(0.384)	(0.221)	(0.456)
opennesstoexperience	0.879	-0.200	-0.351	0.771
	(0.667)	(0.621)	(0.359)	(0.759)
Constant	7.411	12.65**	13.10***	-1.417
	(5.374)	(4.998)	(2.894)	(5.956)
Observations	50	49	50	49
R-squared	0.193	0.100	0.093	0.085

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 shows almost no statistically significant results for any personality trait across all rounds. This suggests that under different environments, the economic incentives play the biggest role in affecting how people make decisions, as the rounds themselves were significant to overall contribution, but no personality factors within the rounds played a major role in predicting contribution.

The final analysis I conducted was to examine the effects of all economic variables and personality traits. The results are shown in Table 7 below.

Table 7: The Effect of Economic and Personality Variables on Overall Contribution

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	overallcontr	overallcontr	overallcontr	overallcontr	overallcontr	overallcontr
2.roundgame	1.178	1.277*	1.729**	1.729**	1.729**	1.729**
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)	(0.706)
3.roundgame	2.548***	2.862***	3.875***	3.875***	3.875***	3.875***
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)	(0.706)
4.roundgame	-0	-0	-0	-0	-0	-0
	(0.725)	(0.749)	(0.718)	(0.718)	(0.718)	(0.706)
altruism		0.287***	0.289***	0.300***	0.302***	0.282**
		(0.0967)	(0.107)	(0.108)	(0.108)	(0.111)
2.gender			-0.484	-0.554	-0.389	-0.397
			(0.547)	(0.554)	(0.581)	(0.599)
3.gender			-0.651	-0.794	-0.583	-1.091
			(1.143)	(1.155)	(1.177)	(1.426)
riskpref				0.0820	0.0772	0.0523
				(0.0933)	(0.0934)	(0.0971)
crt					0.513	1.468**
					(0.549)	(0.671)
extraversion						0.512**
						(0.221)
agreeableness						0.209
						(0.309)
conscientiousness						-0.296
						(0.227)
emotionalstability						-0.434*

						(0.231)
opennesstoexperience						-0.00989
						(0.373)
Constant	3.740***	3.363***	4.874***	4.606***	4.232***	4.076
	(0.513)	(0.588)	(0.598)	(0.671)	(0.782)	(3.145)
Observations	292	260	192	192	192	192
R-squared	0.055	0.101	0.202	0.206	0.209	0.257

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7 shows that altruism and the economic incentives provided by each round are still one of the driving factors towards participants' contributions. Additionally, performance on the cognitive reflection task and extraversion are significant once all variables are included, suggesting that these traits may have some underlying effect on contribution decisions.

VI. Discussion

Although previous research has examined how competition across firms drives effort-based behavior, the effects of environment on behavior at a personal level has not been explored, where people bring their own personal traits, biases, and preferences to the table when deciding how to act. This is a notable gap that has arisen over the past years, as companies and schools have been encouraging and seeking effort-based behavior in risky scenarios, such as innovating a new product or working on a group project. The reported research aimed to fill this gap by exploring how personality traits, risk preferences, and demographics play a role in how people make decisions in environments with different economic incentives.

The results from this study did not show a significant effect of any one of the Big 5 personality traits or risk preferences on contribution amount. However, the different rounds of

the public goods game, each with a unique incentive structure, did have a significant effect on contribution amount. Additionally, altruism had a significant positive effect on contribution amount, even within certain individual rounds. These results, while not able to directly support my hypothesis that personality traits, risk preferences, and demographics play a role in people's behavior under different environments, still present interesting findings about the importance of economic incentives on people's decision making. These findings are consistent with previous findings that changes in economic incentives play a role in determining behavior; for example, changes in wages for lower-income people plays a major role in determining crime rates (Machin & Meghir, 2004).

Overall, these results help to explain how people behave in real-world scenarios where they are incentivized to free-ride off of another person's contribution, such as a group project. If the final grade depends solely on the finished product, individuals have the incentive to put in minimal effort, rely on someone else to bear the brunt of the work, and reap the reward of a good grade without the loss of time and energy. These results also help to explain why other forms of assessing group work may incentivize people to work harder rather than relying on their peers' effort. Conway et al. (1993) found that when students' grades depended on a peer assessment of their group members' contribution to the project, students overall put in more effort to the project. This is similar to the incentive structure in round 3 of the public goods game in my study, in which the payoff was determined by each individual's contribution, rather than the group's contribution. By understanding how an incentive structure drives people's behavior and decision-making, we can start to develop and adjust these structures to promote everyone's best effort.

Although I tried to control for as many aspects of my study as possible to get the most accurate results, I encountered some limitations that may have affected my data. The number of participants may have affected the data because on top of it being a small sample, not every person completed every part of the study, which further reduced my data. For instance, many participants did not fully complete the risk elicitation task, limiting the number of observations, and thus giving me a less accurate sample. Additionally, during the last run of the experiment, data from the public goods game was not collected, as participants were not placed into groups. It is impossible to know exactly what happened with this, as it had not been a problem the previous five times I had run the experiment, but it either could have been a glitch from the server on the experiment side or the data collection side. Additionally, the nature of the sample being students from a small liberal arts school may have affected the data, as there were no participants who scored low on the openness to experience personality trait. I was expecting this personality trait to have a significant effect on contribution, in line with previous literature in which openness to experience was found to positively influence innovative behavior (Yesil & Sozbilir, 2012). However, without a low openness to experience group this was not possible to analyze.

In general, economic incentives are a powerful tool in driving human behavior. With many people facing effort-based scenarios in which they are incentivized to free-ride every day, we could see drastically different behaviors just by changing a few rules to alter the incentive structures. This could lead to people being more productive, helpful, and willing to put in effort, thus reducing the burden on just one person and allowing for synergies of ideas between people. Overall, using Game Theory to model a controlled environment can be extremely insightful to understanding how individual people behave and interact in the world around us every day.

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Appendix: Coding the Experiment

This experiment was coded using the platform Lioness, which uses the coding language Javascript.

I. Consent Form

<h2 style="text-align: center;">Consent Form</h2><h2>Colby College Department of Economics</h2>

Title of the Study: Exerting Effort: A Game Theoretic Approach

Researcher Name(s): Hannah Davidsen

 The general purpose of this research is to analyze how different environments, personality traits, and risk attitudes affect willingness to exert effort. Informed consent is required by Colby College for any person participating in a College-sponsored research study. This study has been approved by the College's Institutional Review Board for Research with Human Subjects.

I hereby give my consent to be the subject of this research study. I acknowledge that the researcher has provided me with:
 A. An explanation of the study's general purpose and procedure. B. Answers to any questions I have asked about the study procedure.

I understand that:
 A. My participation in this study will take approximately 30 minutes. B. No unusual risks are anticipated as a result of participating in this research. C. The potential benefits of this study include gaining a greater understanding of the effect of how workplace environments, personality, and demographics affect innovative behavior. D. I will be compensated for participating in this study with

money. E. My participation is voluntary, and I may withdraw my consent and discontinue participation in the study at any time. My refusal to participate will not result in any penalty. F. The specific nature of and reasons for the procedures employed, those aspects of my behavior that have been recorded for measurement purposes, and what the investigators hope to learn from this study will all be fully explained to me at the end of the session. G. All data collected for this study will be kept confidential. The data will be stored in a secure location, and research reports will only present aggregate statistics without any personally identifying information. H. After the study's purpose and procedure have been fully explained to me, I may, for any reason, choose to withhold use of any data provided by my participation.

By clicking the button below, I consent to participate.

II. Personality Questionnaire

Instructions:

Here are a number of personality traits that may or may not apply to you. Please select a number for each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

Adding the Choices:

I used the "add new element" button to insert 10 radio lines, which I then labeled with the personality statements as shown in the figure on page 14 of this paper. The left label on the radio line was "disagree strongly," and the right label was "agree strongly." I then set the minimum to 1 and the maximum to 7, creating a likert scale from 1-7 for participants to choose from.

III. Cognitive Reflection Task

Question:

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball.

Adding the Answer Box:

I used the "add new element" button to insert a numeric input. I wrote "How much does the ball cost?" in the text box and set the minimum value participants could input to 0 and the maximum to 100. I set the decimal place to 2 and did not require participants to input the correct answer before proceeding to the next part of the experiment.

IV. Risk Elicitation Task

Instructions:

Please select the option that you would prefer (A or B). For example, if Option A says 1/10 of $2, 9/10 of $1.60, this means that you would receive $2 with a 1/10 probability and $1.60 with 9/10 probability (thus making you more likely to end up with $1.60)

Once you have made decisions for all options, one round will be randomly selected and the payoff from the option you chose will be realized. This payoff will be added to your total payoff at the end of the experiment.

Adding the Choices:

I used the "add new element" button to insert 9 discrete choice options. Each discrete choice had a "safe" Option A and a "risky" Option B that participants chose between. The figure on page 15 shows the 9 choices participants made.

Coding the Results:

The code below is to be read top to bottom, then left to right

```
let u =
Math.floor(Math.random()*9)+1;
pie = 0;

let y = Math.random();
if (u == 1) {
    first = getValue('risk1');
    if (y < 1/10) {
        if (first == 1) {
          pie = 2;
        } else {
            pie = 3.85;
        }
    } else {
       if (first == 1) {
          pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 2){
    second = getValue('risk2');
    if (y < 2/10) {
        if (second == 1) {
        pie = 2;
        } else {
        pie = 3.85;
    }
    } else {
        if (second == 1) {
            pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 3){
    third = getValue('risk3');
    if (y < 3/10) {
        if (third == 1) {
        pie = 2;
        } else {
        pie = 3.85;
    }
    } else {
        if (third == 1) {
            pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 4){
    fourth = getValue('risk4');
    if (y < 4/10) {
        if (fourth == 1) {
        pie = 2;
        } else {
        pie = 3.85;
    }
    } else {
        if (fourth == 1) {
            pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 5){
    fifth = getValue('risk5');
    if (y < 5/10) {
        if (fifth == 1) {
        pie = 2;
        } else {
        pie = 3.85;
    }
    } else {
        if (fifth == 1) {
            pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 6){
    sixth = getValue('risk6');
    if (y < 6/10) {
        if (sixth == 1) {
        pie = 2;
        } else {
        pie = 3.85;
    }
    } else {
        if (sixth == 1) {
            pie = 1.60;
        } else {
            pie = 0.10;
        }
    }
    } else if (u == 7){
    seventh = getValue('risk7');
    if (y < 7/10) {
```

```
    if (seventh == 1) {
    pie = 2;
    } else {
    pie = 3.85;
}
} else {
    if (seventh == 1) {
        pie = 1.60;
    } else {
        pie = 0.10;
    }
}
} else if (u == 8){
eighth = getValue('risk8');
if (y < 8/10) {
    if (eighth == 1) {
    pie = 2;
    } else {
    pie = 3.85;
}
} else {
    if (eighth == 1) {
        pie = 1.60;
    } else {
        pie = 0.10;
    }
}
} else if (u == 9){
ninth = getValue('risk9');
if (y < 9/10) {
    if (ninth == 1) {
    pie = 2;
    } else {
    pie = 3.85;
}
} else {
    if (ninth == 1) {
        pie = 1.60;
    } else {
        pie = 0.10;
    }
}
}

record('risk', pie)
```

Results Presented to Participants:

Randomly selected question from last round: u
 Your earning from your choice: $ pie
 Probability that was realized: y

V. Altruism Elicitation Task

Instructions:

<h1>Dictator Game</h1>In this game, you are given 10 points. You can choose to give any amount of these 10 points (between 0 and 10) to the other player. The rest you keep for yourself.

Adding the Answer Box:

I used the “add new element” button to insert a numeric input. In the text box, I wrote “How much do you want to give to Player 2?” and set the minimum response to 0 and the maximum to 10. I set the decimal place to 0.

Coding the Results:

```
gave = getValue('altruism');

endowment = 10;

keep = 10 - gave;

record('dictatorprofit', keep);
```

Results Presented to Participants:

You gave $gave$ of 10 points.   You kept $keep$. These points have been added to your point total.

VI. Public Goods Game

Welcome:

```
var value1USD = 1.0 / exchangeRate;
```

<h2>Public Goods Game</h2>

You will be playing in a group together with one other real person who also accepted this game, who is completing it at the same time.

It is therefore important that you complete this game without interruptions.

Including the time for reading these instructions, the game will take about 15 minutes to complete.

During the game, please do not close this window or leave the game's web pages in any other way.

If you do close your browser or leave the task, you will not be able to re-enter and we will not be able to pay you!

In this game you will play a game with a different person each round for 4 rounds. In these rounds, you can earn Points.

At the end of the game these Points will be converted into real money ($value1USD$ Points = $1.00).

You will receive a code to collect your payment via a Google Form upon completion.

Instructions:

Text Box 1:

<h2>Instructions</h2>

<h3>Your task</h3>

At the beginning of each round, each participant receives 10 Points.

You have to decide how many of the 10 Points you want to contribute to a group project.

The other member of your group makes this decision at the same time.

The Points you do not contribute, you keep for yourself. These Points are added to your total.

After all group members have made their decision, all Points contributed to the group project are added up, and this number of Points is multiplied by $multiplier$.

The resulting number of Points is then divided equally among the group members (irrespective of how much they individually contributed to the group project).

<u>In summary</u>

Your income in a round =

The Points you keep for yourself

plus

The Points you receive from the group project

Text Box 2:

<h3> Group project - Example 1</h3>

- Both players contribute 10 Points to the group project.

- Sum of contributions is 20 Points.

- This amount is multiplied by 1.5, resulting in 30 Points.

- Each participant receives (30 / 2 =) 15 Points from the group project.

- Therefore, the income of each player is 15 Points.
 <div

style="background-color:lightblue">

Text Box 3:

<h3> Group project - Example 2</h3>

- Participants A contributes 10 Points to the group project.

- Participant B contributes 0 Points.

- Sum of contributions is 10 Points.

- This amount is multiplied by 1.5, resulting in 15 Points.

- Each participant receives (15 / 2 =) 7.5 Points from the group project.

- Therefore, the income of Participants A is 7.5 Points.

- The income of Participant B is 17.5 Points (10 kept for himself plus 7.5 from the group project).

Text Box 4:

Please make your decisions within the time limit shown on your screen. If you fail to do so, you will be removed from the HIT.

After all members of your group have made their decision, the results of the round will be shown to you.
Once all players in your group are finished, a new round will begin.

Again, you will receive 10 Points to start with.
The game will end after four rounds, each with their own set of rules. A brief questionnaire will conclude this game.

Please click the link below if you understood the instructions.

Before the game itself starts, a brief quiz will check whether you understand your task.

Control Questions:

Question 1:

<h2>Control questions</h2>

Please answer all control questions. These serve as a test for your understanding of the game. <p>If you need to consult the instructions again, there is a button at the bottom that will bring you back.

1. At the start of a round, each group member receives 10 Points. Suppose nobody (including you) contributes

any Points to the project.</p>

Answer Box:

I used the "add new element" button to insert a numeric input. In the text box, I wrote "How many points would you earn?" and I set the minimum input to 0 and the maximum to 100. I set the decimal place to 0. In order to ensure the participants understood the game, I made this question required, and participants were unable to continue until they input the correct answer.

I then used the "add new element" button to insert another numeric input. In the text box, I wrote "How many points would each of the other group members earn?" and I set the minimum input to 0 and the maximum to 100. I set the decimal place to 0. In order to ensure the participants understood the game, I made this question required, and participants were unable to continue until they input the correct answer.

Question 2:

<h2>2. Suppose the other member of your group contributes 10 Points to the project.
</h2>

Answer Box:

I used the "add new element" button to insert a numeric input. In the text box, I wrote "How many points would you earn if you contribute 10 points?" and I set the minimum input to 0 and the maximum to 100. I set the decimal place to 0. In order to ensure the participants understood the game, I made this question required, and participants were unable to continue until they input the correct answer.

I then used the “add new element” button to insert another numeric input. In the text box, I wrote “How many points would you earn if you contribute 0 points?” and I set the minimum input to 0 and the maximum to 100. I set the decimal place to 0. In order to ensure the participants understood the game, I made this question required, and participants were unable to continue until they input the correct answer. I also programmed the game to place players in a lobby so they could be paired up with another participant before proceeding with the experiment.

Treatment 1:

Instructions:

<h2>Round $period$</h2>

A new round has started.

You received 10 Points to start with.

Answer Box:

I used the “add new element” button to insert a numeric input. I wrote “Your contribution to the group project” in the text box, and set the minimum contribution to 0 and the maximum to 10. I set the decimal place to 0.

Treatment 1 Results:

Coding the Results:

```
endowment = 10;
myContr = getValue('contribution');
keptForSelf = endowment - myContr;
allContr = getValues('contribution');
othersContr = getValuesOthers('contribution');

sum = 0;
for (var i=0; i<allContr.length; i++) sum += allContr[i];
averageContribution = sum / currentGroupSize;
product = sum * multiplier;
share = product / currentGroupSize;
earningsThisPeriod = keptForSelf + share;
```

```
averageContributionT = averageContribution.toFixed(1);
productT = product.toFixed(1);
shareT = share.toFixed(1);
earningsT = earningsThisPeriod.toFixed(1);

record('earningsThisPeriod', earningsT);

totalEarnings = 0;
if (period>0){
for (var i = 1; i<=period; i++){
    payThisPeriod = getValue('decisions', 'playerNr='+playerNr+' and
period='+i, 'earningsThisPeriod');
    totalEarnings+=payThisPeriod;
}
}

totalEarningsT = totalEarnings.toFixed(1);
yyy = totalEarnings;
record('round1', yyy);
```

Results Presented to Participants:

<h2>Round $period$ </h2>

Results

Your contribution to the group project: $myContr$.

Average contribution in your group: $averageContributionT$.
Sum of contributions in your group: sum.
This amount is multiplied by $multiplier$, yielding $productT$.
Each group member receives an equal share: $shareT$.

Your earnings Points kept for yourself: $keptForSelf$.
Your share from the group project: $shareT$<span style="line-height: 1.4em;

background-color: initial;">. Your total earnings in this round:

$earningsT$.

Treatment 2:

Instructions:

<h1>Round 2</h1> A new round has started. You received 10 Points to start with. In this round, if the total pot does not reach 15 points (i.e. if you and your group member do not contribute a total of 15 points), the pot will not be multiplied and you will lose any points you contributed.

Answer Box:

I used the "add new element" button to insert a numeric input. I wrote "Your contribution to the group project" in the text box, and set the minimum contribution to 0 and the maximum to 10. I set the decimal place to 0.

Treatment 2 Results:

Coding the Results:

```
endowment = 10;
myContr = getValue('contribution2');
keptForSelf = endowment - myContr;
allContr = getValues('contribution2');
othersContr = getValuesOthers('contribution2');

sum = 0;
for (var i=0; i<allContr.length; i++) sum += allContr[i];
averageContribution = sum / currentGroupSize;
product = sum * multiplier;
share = product / currentGroupSize;
if (sum <15) {
share = 0;
}

earningsThisPeriod = keptForSelf + share;
averageContributionT = averageContribution.toFixed(1);
productT = product.toFixed(1);
shareT = share.toFixed(1);
earningsT = earningsThisPeriod.toFixed(1);
```

```
record('earningsThisPeriod', earningsT);

totalEarnings = 0;
if (period>0){
for (var i = 1; i<=period; i++){
    payThisPeriod = getValue('decisions', 'playerNr='+playerNr+' and
period='+i, 'earningsThisPeriod');
    totalEarnings+=payThisPeriod;
}
}

totalEarningsT = totalEarnings.toFixed(1);
www = totalEarnings;
record('round2', www);
record('totalEarnings', totalEarningsT);
```

Results Presented to Participants:

If total ≥ 15

<h1>Round 2 </h1> Results <blockquote> Your contribution to the group project: $myContr$.
 Average contribution in your group: $averageContributionT$.
Sum of contributions in your group: sum. </blockquote><blockquote>The 15 points were met.</blockquote><blockquote>This amount is multiplied by $multiplier$, yielding $productT$.
Each group member receives an equal share: $shareT$. </blockquote> Your earnings <blockquote> Points kept for yourself: $keptForSelf$.
Your share from the group project: $shareT$.
 Your total earnings in this round: $earningsT$.</blockquote>

If total <15

<h1>Round 2 </h1> Results <blockquote> Your contribution to the group project: $myContr$.
 Average contribution in your group: $averageContributionT$.
Sum of contributions in your group: sum. </blockquote><blockquote>The 15 points were not

met. </blockquote><blockquote>Remember, if the pot did not reach a total of 15 points, the pot was not multiplied and you lost any points you originally contributed.</blockquote> Your earnings <blockquote> Points kept for yourself: $keptForSelf$.
Your share from the group project: $shareT$.
 Your total earnings in this round: $earningsT$.</blockquote>

Treatment 3:

Instructions:

<h1>Round 3</h1> A new round has started. You received 10 Points to start with. In this round, you will receive points based on the proportion of the total pot that you contributed to. For instance, if you put in 10 and your partner puts in 0, you will receive 10*1.5=15 points and your partner will not receive any points.

Answer Box:

I used the "add new element" button to insert a numeric input. I wrote "Your contribution to the group project" in the text box, and set the minimum contribution to 0 and the maximum to 10. I set the decimal place to 0.

Treatment 3 Results:

Coding the Results:

```
endowment = 10;
myContr = getValue('contribution3');
keptForSelf = endowment - myContr;
allContr = getValues('contribution3');
othersContr = getValuesOthers('contribution3');

sum = 0;
for (var i=0; i<allContr.length; i++) sum += allContr[i];
averageContribution = sum / currentGroupSize;
product = myContr * multiplier;
share = product;
```

```
earningsThisPeriod = keptForSelf + share;

totalpot = sum * multiplier;

averageContributionT = averageContribution.toFixed(1);
productT = product.toFixed(1);
shareT = share.toFixed(1);
earningsT = earningsThisPeriod.toFixed(1);
totalpotT = totalpot.toFixed(1);

record('earningsThisPeriod', earningsT);

totalEarnings = 0;
if (period>0){
for (var i = 1; i<=period; i++){
    payThisPeriod = getValue('decisions', 'playerNr='+playerNr+' and
period='+i, 'earningsThisPeriod');
    totalEarnings+=payThisPeriod;
}
}
totalEarningsT = totalEarnings.toFixed(1);
uuu = totalEarnings;
record('round3', uuu);
record('totalEarnings', totalEarningsT);
```

Results Presented to Participants:

<h1>Round 3 </h1> Results <blockquote> Your contribution to the group project: $myContr$.
 Average contribution in your group: $averageContributionT$.
Sum of contributions in your group: sum.
This amount is multiplied by $multiplier$, yielding $totalpotT$.
Each group member receives a share proportional to what they put in. Your share is: $shareT$. </blockquote> Your earnings <blockquote> Points kept for yourself: $keptForSelf$.
Your share from the group project: $shareT$.
 Your total earnings in this round: $earningsT$.</blockquote>

Treatment 4:

Coding the Dynamic Game:

```
var roleNames = ['A','B'];

var roles = [
        [1,1,2,1,1,2,1,1],
        [2,1,2,1,2,1,2],
        [2,2,1,2,2],
        ];


var currRole = roles[subjectNr-1][period-1];
var roleTxt = roleNames[currRole-1];

record('roleTxt', roleTxt);
```

Instructions:

If Player Role = A

<h1>Round 4</h1> A new round has started. You received 10 Points to start with. Your role is: $roleTxt$ This means that you select your amount first.

Player A Answer Box:

I used the "add new element" button to insert a numeric input. I wrote "Your contribution to the group project" in the text box, and set the minimum contribution to 0 and the maximum to 10. I set the decimal place to 0.

If Player Role = B

<h1>Round 4</h1> A new round has started. You received 10 Points to start with. Your role is: $roleTxt$ You will observe what player A puts in, then decide how much you want to contribute

After Player A has made their contribution

$playerRole$ Player A contributed: $playerA$ points.

Player B Answer Box:

I used the “add new element” button to insert a numeric input. I wrote “Your contribution to the group project” in the text box, and set the minimum contribution to 0 and the maximum to 10. I set the decimal place to 0.

Treatment 4 Results:

Coding the Results:

```
var roleNames = ['A','B'];

var roles = [
        [1,3,1,2,1,3,1,2,1,1],
        [2,1,2,1,2,1,2,3,3,3],
        [3,2,3,3,3,2,3,1,2,2]
            ];

var currRole = roles[subjectNr-1][period-1];
var roleTxt = roleNames[currRole-1];

endowment = 10;
myContr = getValue('contribution4');
keptForSelf = endowment - myContr;
allContr = getValues('contribution4');
othersContr = getValuesOthers('contribution4');

sum = 0;
for (var i=0; i<allContr.length; i++) sum += allContr[i];
averageContribution = sum / currentGroupSize;
product = sum * multiplier;
share = product / currentGroupSize;
earningsThisPeriod = keptForSelf + share;

averageContributionT = averageContribution.toFixed(1);
productT = product.toFixed(1);
shareT = share.toFixed(1);
earningsT = earningsThisPeriod.toFixed(1);

record('earningsThisPeriod', earningsT);

totalEarnings = 0;
if (period>0){
for (var i = 1; i<=period; i++){
    payThisPeriod = getValue('decisions', 'playerNr='+playerNr+' and
period='+i, 'earningsThisPeriod');
    totalEarnings+=payThisPeriod;
}
}
```

```
totalEarningsT = totalEarnings.toFixed(1);
sss = totalEarnings;
record('round4', sss);
record('totalEarnings', totalEarningsT);
```

Results Presented to Participants:

<h1>Round 4 </h1> Results <blockquote> Your contribution to the group project: $myContr$.
 Average contribution in your group: $averageContributionT$.
Sum of contributions in your group: sum.
This amount is multiplied by $multiplier$, yielding $productT$.
Each group member receives an equal share: $shareT$. </blockquote> Your earnings <blockquote> Points kept for yourself: $keptForSelf$.
Your share from the group project: $shareT$.
 Your total earnings in this round: $earningsT$.</blockquote>

VII. Demographics Survey

Age:

I used the "add new element" button to insert a numeric input. I wrote "What is your age?" in the text box and set the minimum response to 18 and the maximum to 100. I set the decimal place to 0.

Gender:

I used the "add new element" button to insert a discrete choice. I wrote "What gender do you identify as?" in the text box and provided four options for participants to choose from: "Male," "Female," "Non-Binary," and "Prefer not to say."

Language:

I used the “add new element” button to insert a discrete choice. I wrote “Is English your native language?” in the text box and provided two options for participants to choose from: “Yes” and “No.”

Race:

I used the “add new element” button to insert a text input. I wrote “What is your race?” in the text box and set the minimum characters for participants’ responses to 0 and the maximum to 1000.

Major:

I used the “add new element” button to insert a text input. I wrote “What is your major?” in the text box and set the minimum characters for participants’ responses to 0 and the maximum to 1000.

Interference Check:

I used the “add new element” button to insert a discrete choice. I wrote “Are any of the statements below true of you (click all that apply)? Please note that you will receive compensation regardless of how you respond to this question. This just helps us assess the data we are receiving” in the text box and provided 5 statements: “I didn’t read the instructions carefully,” “I just clicked through the questions without paying much attention to them,” “Other people were distracting me during the study by talking,” “A friend told me what this study was about before I participated,” and “None of the above statements are true of me.” Participants could select multiple statements if they felt the statements applied to them.

VIII. Debriefing Form

h2>Debriefing Form</h2><h2>Colby College Department of Economics</h2> Title of the Study: Exerting Effort: A Game Theoretic Approach Researcher Name(s):

Hannah Davidsen Thank you for participating in this research study. I am conducting this study to examine how different environments, personality traits, and risk preferences affect willingness to exert effort in situations that involve some degree of risk. My main research question is: If effort levels differ between individuals, do different people exhibit a higher willingness to exert effort under different conditions?   While participating in this study, you completed a personality measure that will determine how strongly you align with each of the Big Five personality traits. You then completed a number puzzle to examine a base line of creative thinking. Next, you completed a risk elicitation task to discover your risk preferences. Finally, you played a Public Goods game to determine how different environments affected your willingness to exert effort. I expect to find that participants who are high in the personality trait openness to experience will be more willing to exert effort in risky scenarios than other personality traits. I also expect participants will be more willing to exert effort under cooperative conditions than competitive or dynamic environments.   If you are interested in learning more about this study, please feel free to ask me questions in person, or contact me at hmdavi22@colby.edu. If you would like to learn more about Game Theory, personality, and effort-driven behavior, I recommend the following readings: Baniak, A., & Dubina, I. (2012). Innovation analysis and game theory: A review. Innovation, 14(2), 178-191. Dubina, I. (2010). Innovation project participants interaction optimization models. In R. Trappl (Ed.), Cybernetics and systems 2010. Vienna, Austria: Austrian Society for Cybernetic Studies. Yesil, S., & Sozbilir, F. (2013). An empirical investigation into the impact of personality on individual innovation behaviour in the workplace. Procedia-Social and Behavioral Sciences, 81, 540-551. If you have any concerns about your rights as a

participant in this study, please contact the Chair of the Colby Institutional Review Board for Research with Human Subjects, Tarja Raag (tarja.raag@colby.edu). Thank you again for participating!
 <h2></h2>

IX. Total Earnings

Coding Expected Earnings:

```
randomid = getInt('session', 'playerNr='+playerNr, 'randomid');
record('randomid', randomid);
gave = getValue('altruism');
a = getValue('round1');
b = getValue('round2');
c = getValue('round3');
d = getValue('round4');
e = getValue('dictatorprofit');
f = getValue('risk');

totalEarnings1 = a+b+c+d+e;
valuePoints = exchangeRate * totalEarnings1;
total = (valuePoints) + (participationFee) + (f);
record('totalEarnings1', total);
extrabonus = valuePoints + f;

setValue('session', 'playerNr='+playerNr, 'bonusAmount', extrabonus);
setValue('session', 'playerNr='+playerNr, 'totalEarnings', total,
getGlobal('keep'));

setBonus(valuePoints);
```

Results Presented to Participants:

If group number ≠ 0:

<h2> Your Earnings</h2>

During this game you have earned $totalEarnings1$ Points.

These points are worth $ $valuePoints$. From the risk elicitation task you earned: $ f. Your guaranteed participation fee is: $ $participationFee$.

So, in total, you have earned $ $total$.

To receive your earnings, please click on the link below to enter the game-generated random ID and your Colby ID.

Random ID (copy this number!!): $randomid$ Click here to receive your earnings: https://docs.google.com/forms/d/e/1FAIpQLSceGDWYxZxu2bmbYy6UGgkn9ehflU_VDWuk1yZhbFbkObC4mQ/viewform?usp=sf_link

After you have done that, you can close this window. Thank you for participating in my study!

If group number = 0:

<h2> Your earnings</h2>

We could not match you with other group members. Your guaranteed participation fee is: $ $participationFee$.
 To receive your earnings, please click on the link below to enter the game-generated random ID and your Colby ID. Random ID (copy this number): $randomid$
 Click here to receive your earnings: https://docs.google.com/forms/d/e/1FAIpQLSceGDWYxZxu2bmbYy6UGgkn9ehflU_VDWuk1yZhbFbkObC4mQ/viewform?usp=sf_link

After you have done that, you can close this window.

We thank you for participating in our study.